Jet-Veto Efficiency Study on Data using Zs

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Outline

- The jet-veto signal efficiency and systematics
- The jet-veto efficiency calibration in Z data
  - Dataset and Z selections
  - Jet Et spectrum and JetVeto efficiency for jets with $3<|\eta|<5$
    - Jet Et spectrum and JetVeto efficiency for jets with $|\eta|<5$
      - Results based on the uncorrected jets
      - JEC correction effects on the results
- The WW/Z jet-veto efficiency ratio on MC
- Summary

JetVeto Signal Efficiency

- One way to estimate jet-veto signal efficiency

$$\epsilon_{WW}^{data} = \epsilon_{Z}^{data} \times \frac{\epsilon_{WW}^{data}}{\epsilon_{Z}^{data}} \dashrightarrow R_{WW/Z}^{data}$$

$$\epsilon_{WW}^{data} = \epsilon_{Z}^{data} \times R_{WW/Z}^{MC}$$

  - Main question in estimating the systematic error on jet-veto signal efficiency is how well does the MC reproduces data in this ratio?

    - First we look at the Z data to see the data/MC matching

    - Select the MCs with good data/MC matching in the control region (Z), and assign half of the biggest difference in Rww/z as the systematic error on Rww/z

      - Pitfall: what if both MCs are wrong in predicting the Rww/z? However we don't have a good reason for this to happen

- Propagate the errors on ϵ_{Z}^{data} and Rww/z for the systematic error on WW jet veto signal efficiency

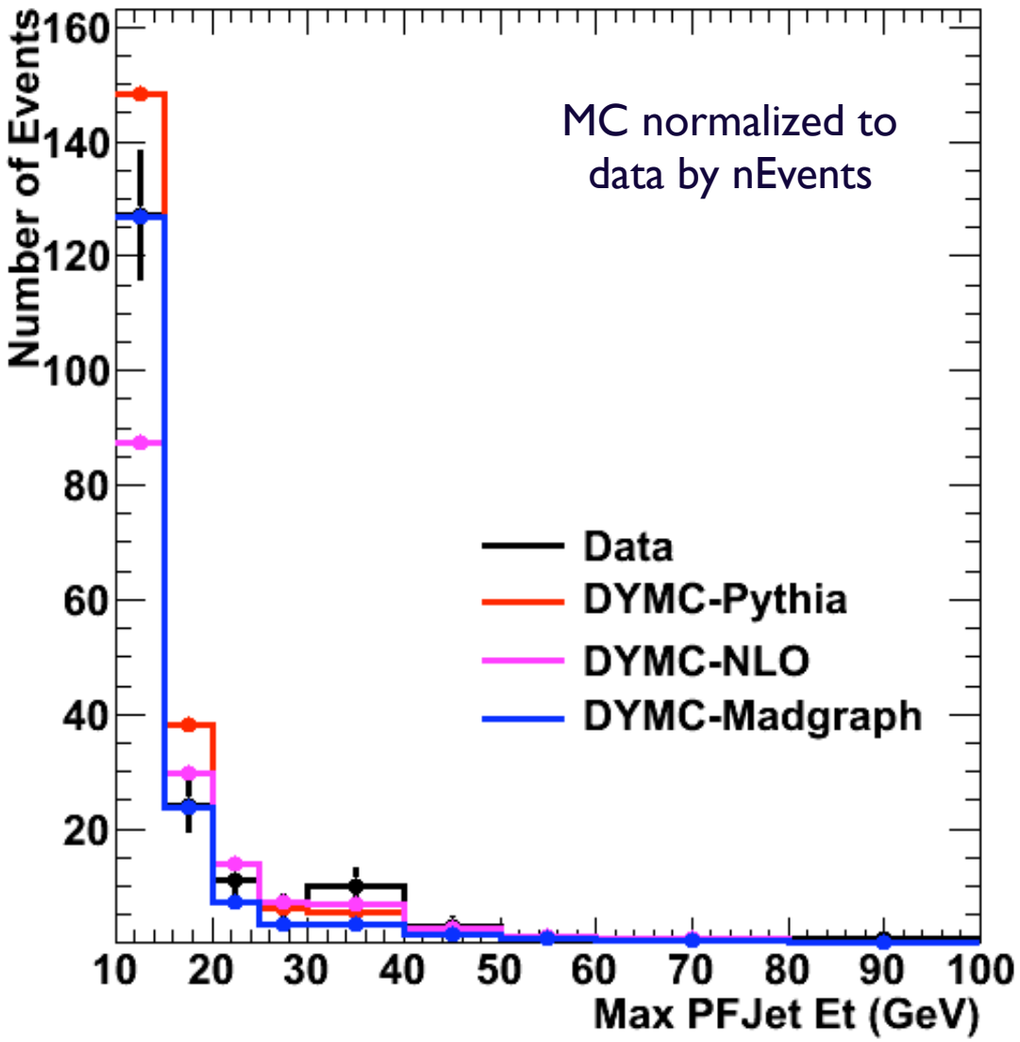
Datasets

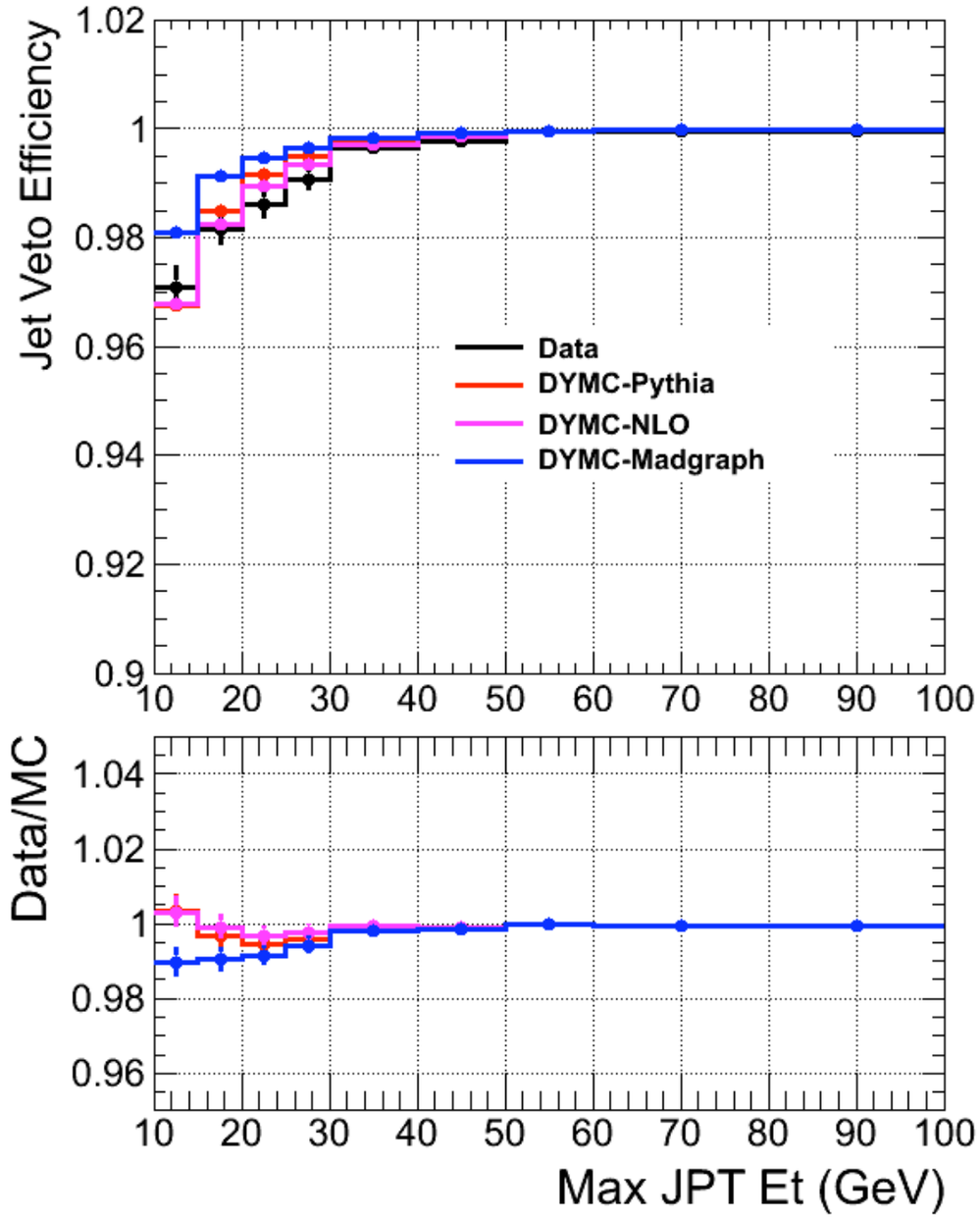
- Data
  - 3.1/pb corresponding to the certified JSON file provided on 09/11
- DY MCs (ll: ee + mumu)
  - Pythia: /Zll_Spring10-START3X_V26_S09-v1/
  - Madgraph: /ZJets-madgraph_Spring10-START3X_V26_S09-v1/
  - NLO: /Zgamma_ll_M20-mcatnlo_Spring10-START3X_V26_S09-v1/
- WW MCs
  - Pythia: /WW_Spring10-START3X_V26_S09-v1
  - Madgraph: /VVJets-madgraph_Spring10-START3X_V26_S09-v1/
  - NLO: /WWtoEE-mcatnlo_Spring10-START3X_V26_S09-v/
    - + EPlusMuMinus, EPlusTauMinus, MuMu, MuPlusEMinus, MuPlusTauMinus, TauTau, TauPlusEMinus, TauPlusMuMinus

Z Selections

- Z selection differences from WW reference
  - |M(ll)- 91.1876| <15 GeV in EE/MM
  - If multiple hypo. are found, choose the one with m(ll) closest to Z mass
  - Relax all jet-veto and MET cuts
  - Relax all trigger selections
  - Relax soft muon and third lepton vetos
- Number of Events after the Z selection: 629 (EE) 1109 (MM)

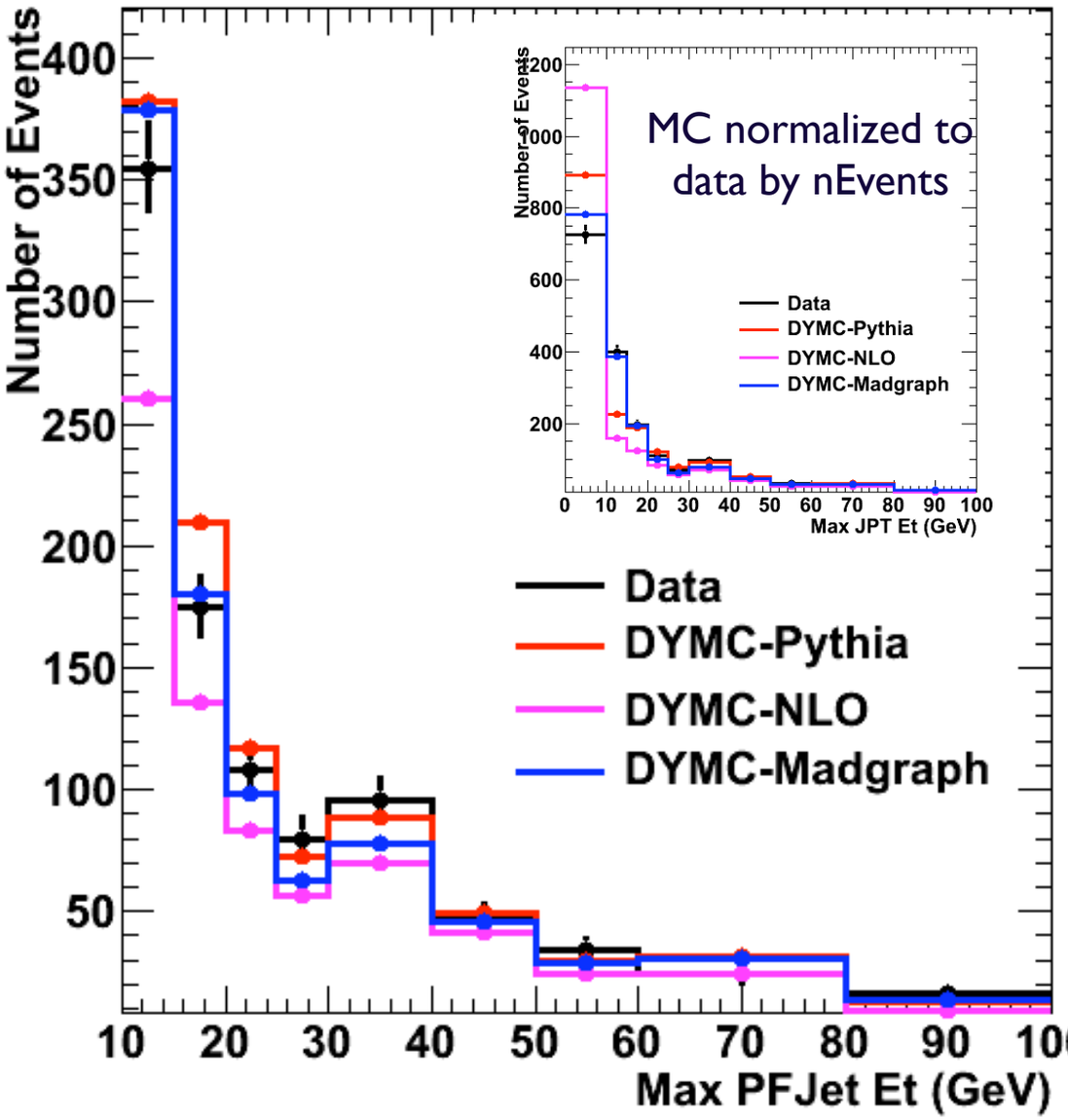
PF Jets 3|<η|<5 (EE+MM)

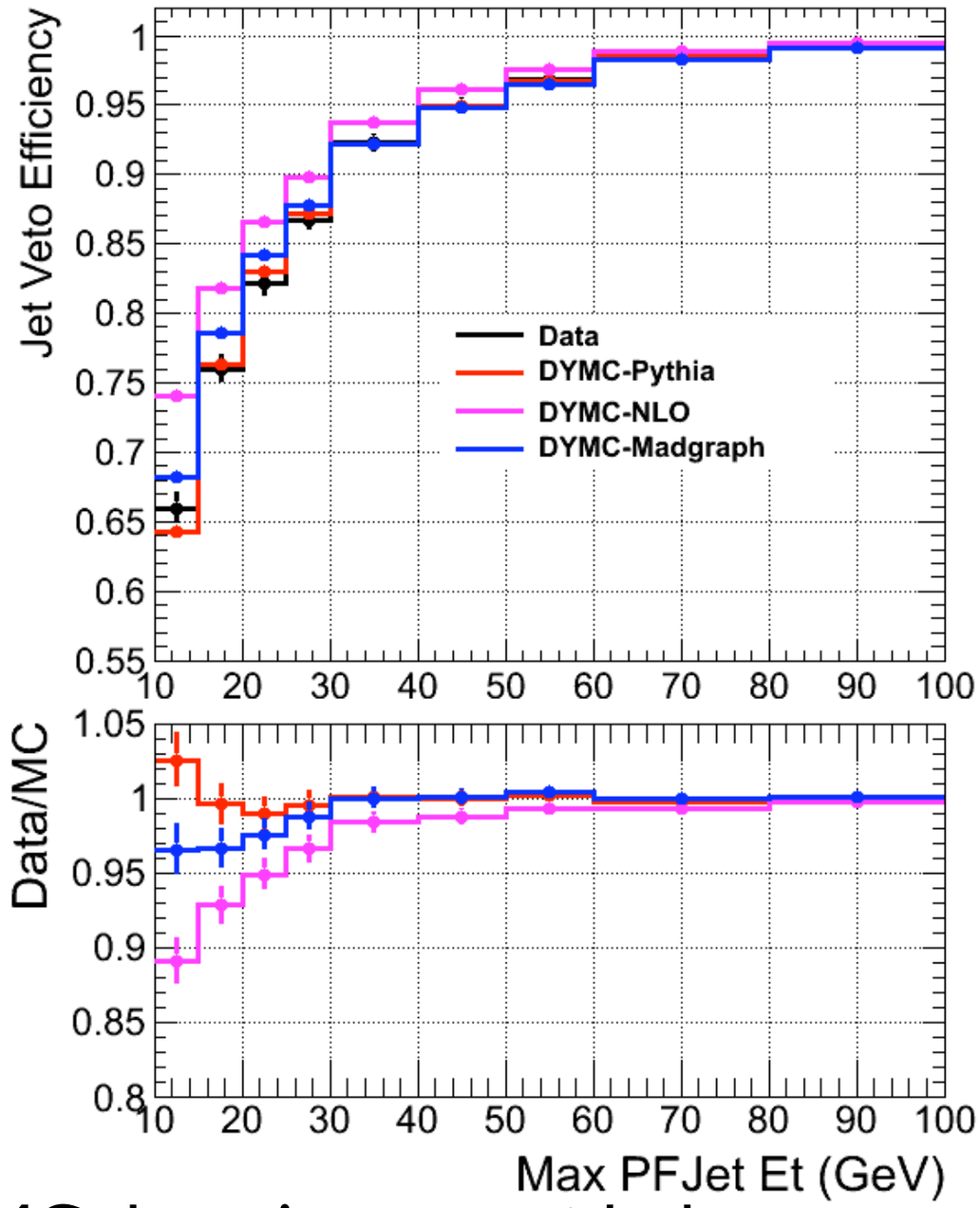




- The jet-veto efficiency data/MC ratio is ~ 1
- This is confirmed with JPT and Trk Jets
- It is safe to increase the jet veto to |eta|<5

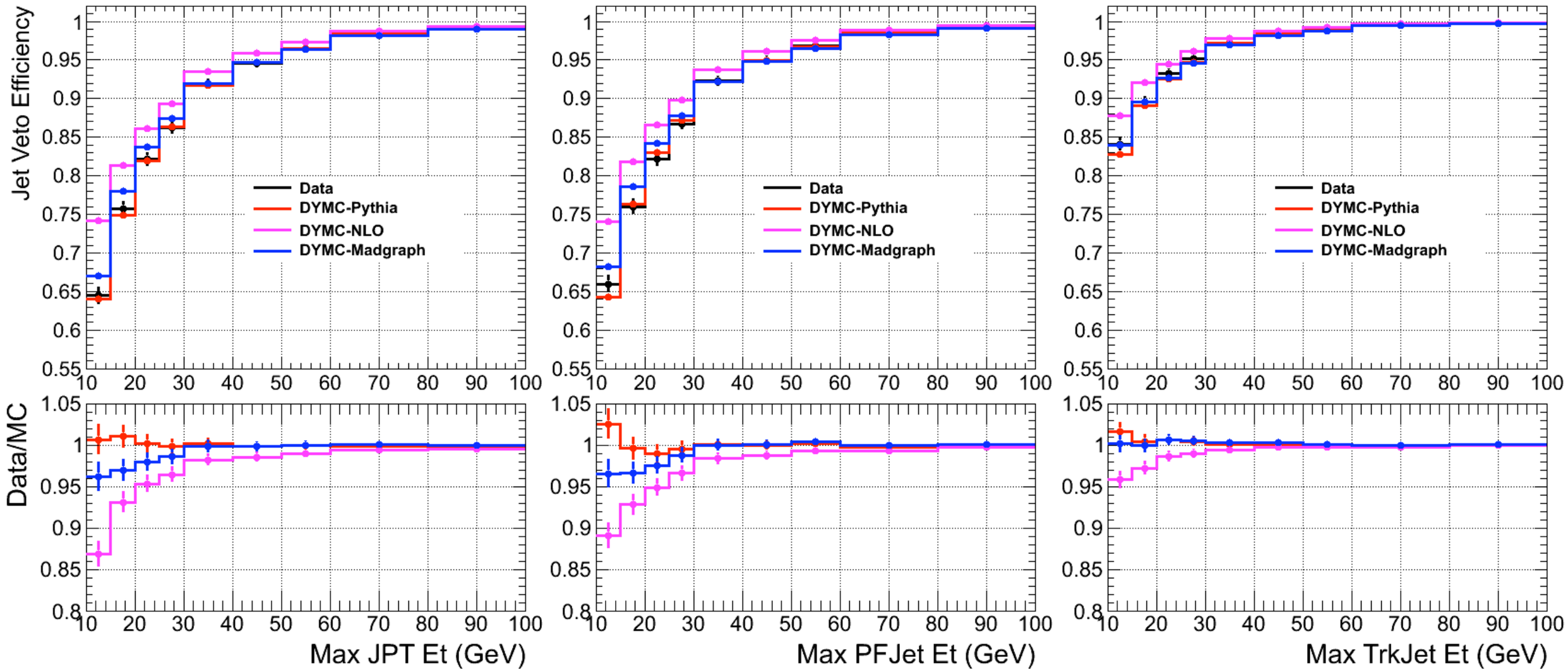
PF Jets |η|<5 (EE+MM)





- The jet energy spectrum of NLO MC doesn't agree with data
- The Data/MC ratio is close to 100% for Pythia and Madgraph
  - This may be because the MC are tuned well on the Z data

Compare Uncorrected Jets (|η|<5)



- The JetVeto efficiency on data and the data/MC ratio for 20 GeV(25GeV)

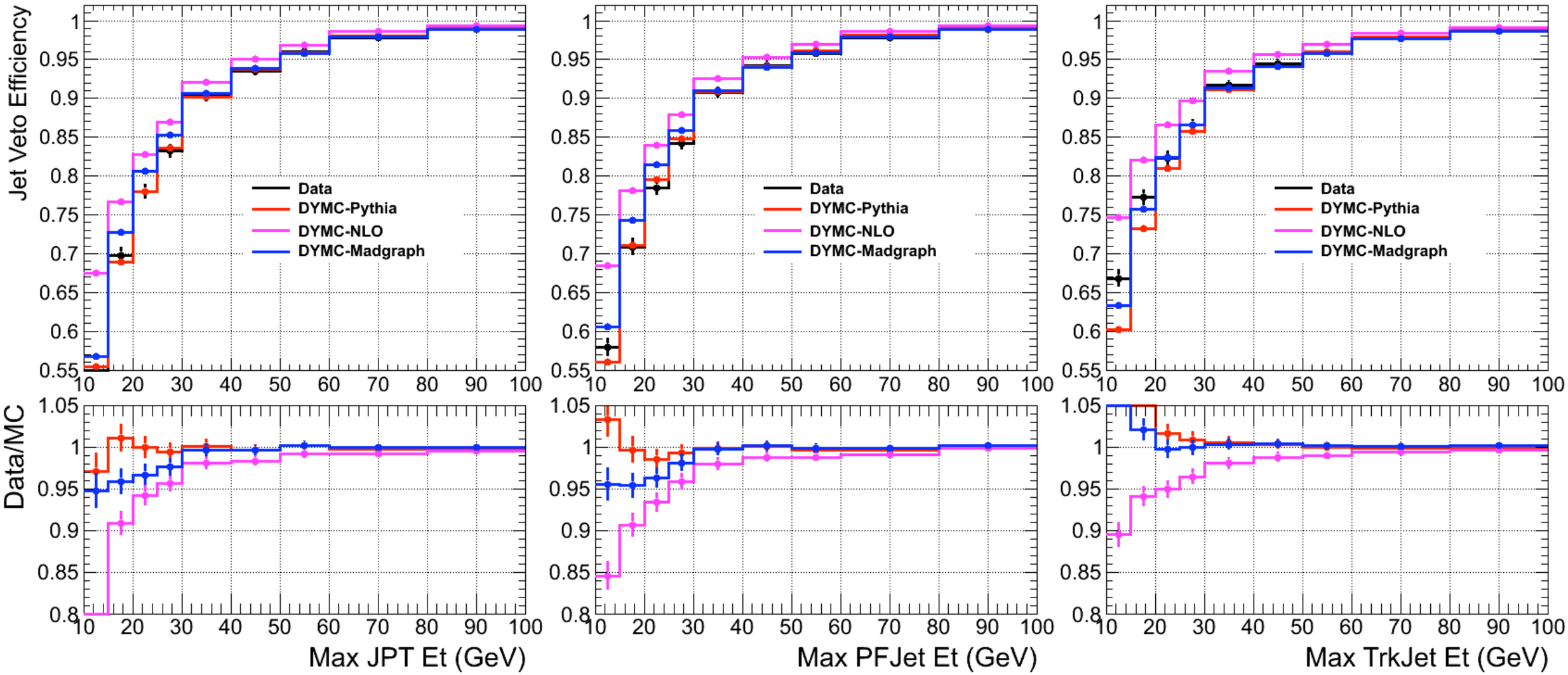
	JPT	PF	TrkJet
Efficiency on data	82%(86%)	82%(87%)	93.5%(95%)
data/MC Pythia	101%(100%)	99%(99%)	100%(100%)
data/MC Madgraph	98%(98.5%)	97.5%(96.5%)	100%(100%)

- JPT/PF performs similarly without JEC. For TrkJet, JEC could be as large as 100%

Jet Energy Corrections

- JEC instructions from Konstantinos Kousouris
  - https://twiki.cern.ch/twiki/bin/view/CMS/WorkBookJetEnergyCorrections
- Apply L2(Relative)+L3(Absolute) corrections on data/MC
- Apply small residual corrections on data
  - https://hypernews.cern.ch/HyperNews/CMS/get/JetMET/1017.html
  - http://indico.cern.ch/getFile.py/access?contribId=2&resId=0&materialId=slides&confId=99954

Compare Corrected Jets (|η|<5)

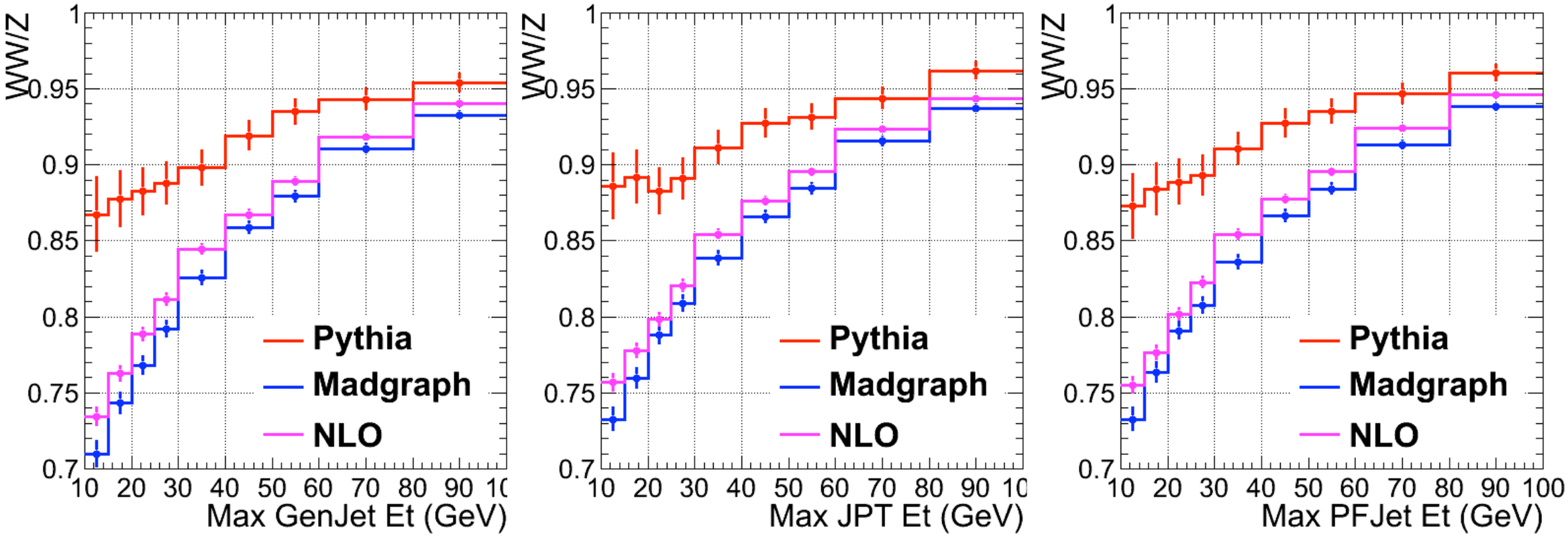


- Efficiency using trkJet is within 5% from the JPT/PF
- The data/MC agreement is similar to the performance on jets without JEC
- The jet veto efficiency at 20 GeV (25GeV) is a few % less than the uncorrected jet results

	JPT	PF	TrkJet
Efficiency on data	78%(83%)	78%(84%)	82%(86%)
data/MC Pythia	100%(100%)	98%(99%)	102(101%)
data/MC Madgraph	97%(97.5%)	97%(98%)	100%(100%)

WW/Z Jet-Veto Efficiency Ratio

- WW Selections: reference cuts without JetVeto and Z selections: Slide 4



- JetVeto efficiency ratio WW/Z difference at 20GeV(25GeV)

	GenJet	JPT	PF
Pythia-Madgraph	11%(10%)	10%(8%)	9%(8%)
Madgraph-NLO	2%(2%)	1%(1%)	1%(2%)

- The large difference of Pythia from Madgraph/NLO may indicate that hard ISR is not modeled well in Pythia. This needs more investigation

Summary

- We introduced one jet-veto signal efficiency estimation method, based on jet-veto efficiency in z data and the WW/Z efficiency ratio in MC
- We studied the jet veto efficiency in the control region (Z) on data
  - The data/MC ratio for jets at HF region ($3<|\eta|<5$) is ~ 100%, we propose to extend the jet veto region to $|\eta|<5$
  - The jet energy spectrum in the NLO MC is softer than data
  - The jet veto efficiency data/MC is > 96% for pythia and madgraph
  - Performance on jets with JEC are similar as the uncorrected ones
- We looked into the WW/Z jet veto efficiency ratio in the MC
  - The madgraph and mc@nlo differs by only 2%
  - The WW/Z ratio in pythia differs from madgraph/nlo by ~10%. This needs more study to see if this difference is a really a physics effect rather than the issue with the generator or sample.